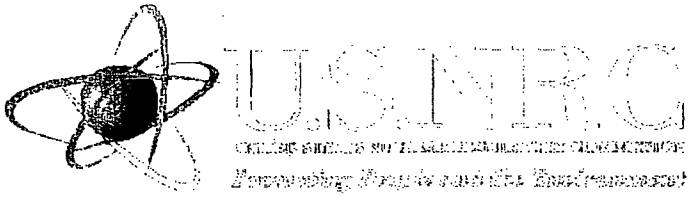


State of the Art Reactor Consequence Analysis Emergency Response Modeling

Health Physics Society

Midyear Conference

February 3, 2009

Randolph Sullivan, CHP

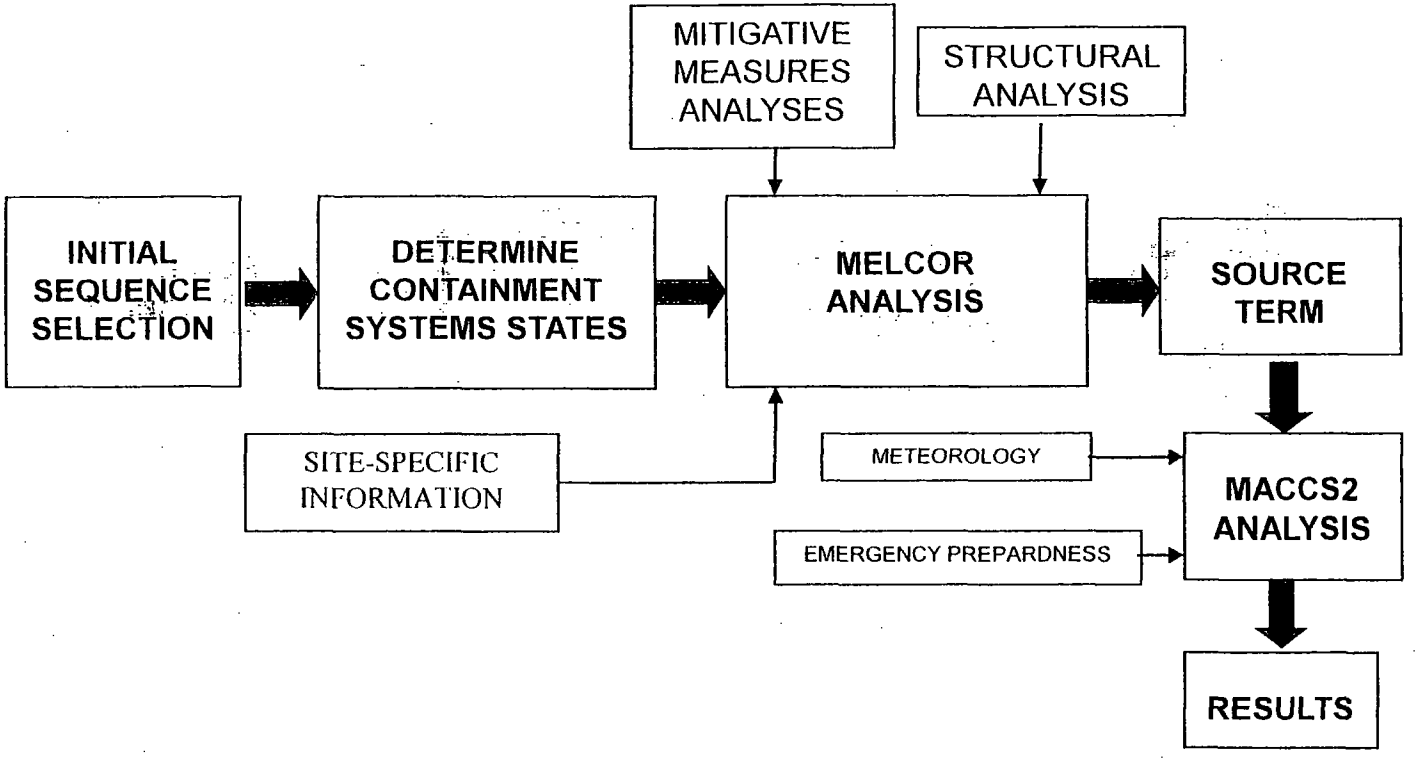
Overview

- State-of-the-art more realistic evaluation of severe nuclear plant accident progression, radiological releases and offsite consequences

- Analysis of pilot plants (Peach Bottom, Surry) for probabilistically important sequences (e.g., Station Black Out, Interfacing System LOCA)

- Account for plant design and operational improvements, credit existing and newly developed mitigative measures and site specific emergency plans

SOARCA PROCESS



Objective

- Realistically model emergency response during a severe reactor accident
- Evolutionary improvement over past EP modeling of severe reactor accident consequences

Assumptions

- Emergency plans will be implemented
- The public will largely obey direction from officials
- Emergency workers will implement plans

Technical Basis

- Site, State and local emergency plans
- Site procedures used to classify emergencies based on accident progression
- State/local protective action procedures
- Evacuation Time Estimates (ETE)
- Oak Ridge Evacuation Modeling System for evacuation beyond EPZ

Identify Cohorts

- ETE data:
  - General public (90%)
  - "Tail" of public (10%)
  - Special needs
  - Schools

Identify Cohorts

- Non-evacuating (0.5%)
- Shadow evacuation (20%)

Speed of Travel

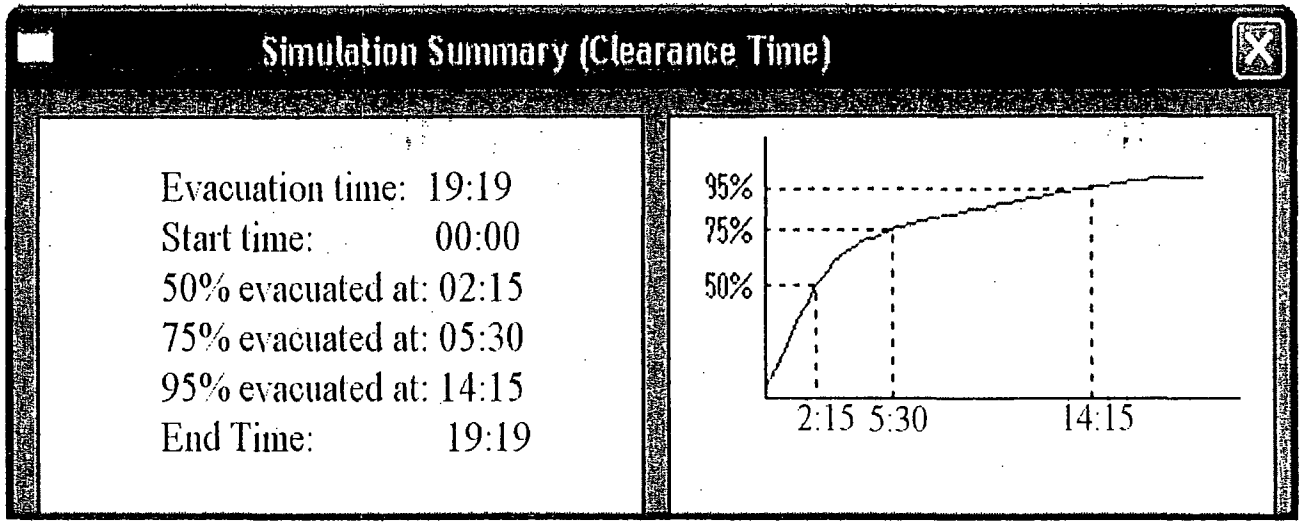
- Determined from ETE
- Modified in space and time
  - "Bottle necks" identified
  - Free flowing areas identified
  - Road loading timing

Example ETE

Region	Population	Non-Evacuating	Evacuated	Number of Vehicles
0-10	71,400	400	71,000	41,000
10-20	392,000	1,900	390,100	223,000
Total	**463,400**	**2,300**	**461,100**	**264,000**

Evacuation Times

- EPZ: 0-10 miles
  - 6.5 hours (from ETE)
- 0-20 miles
  - 19:19 hours (OREMS)



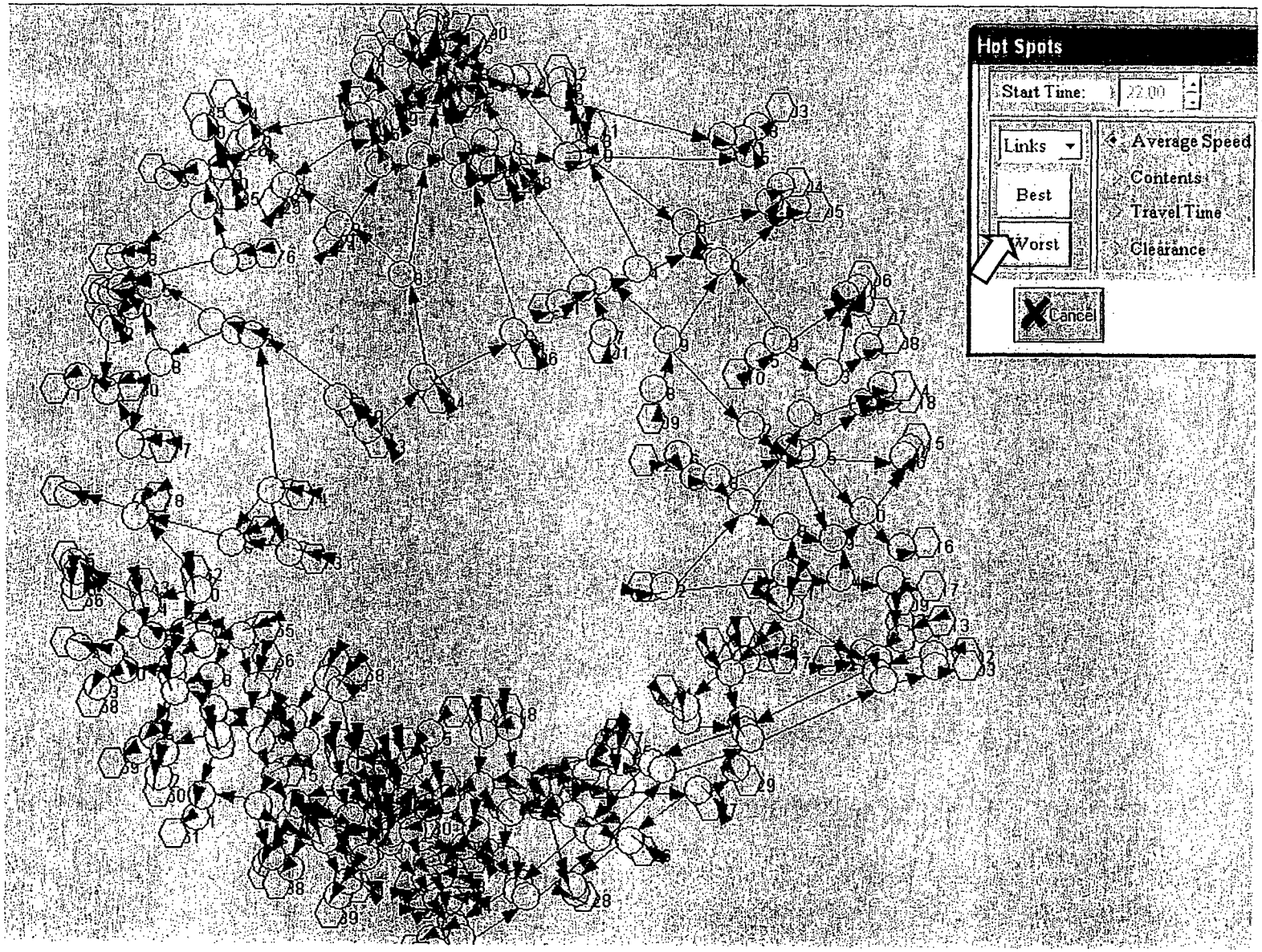
Typical distribution for evacuation time

- **Total evacuation time 19 hours, 19 minutes**

Speed of Travel

- Road network modeled
- Median speed of cohort assumed
  - Speeds adjusted for areas of free flow or congestion
- Median speed equals dist/time to clear

Evacuation Model (10-20 miles)



Oak Ridge Evacuation Modeling System (OREMS), v. 2.60

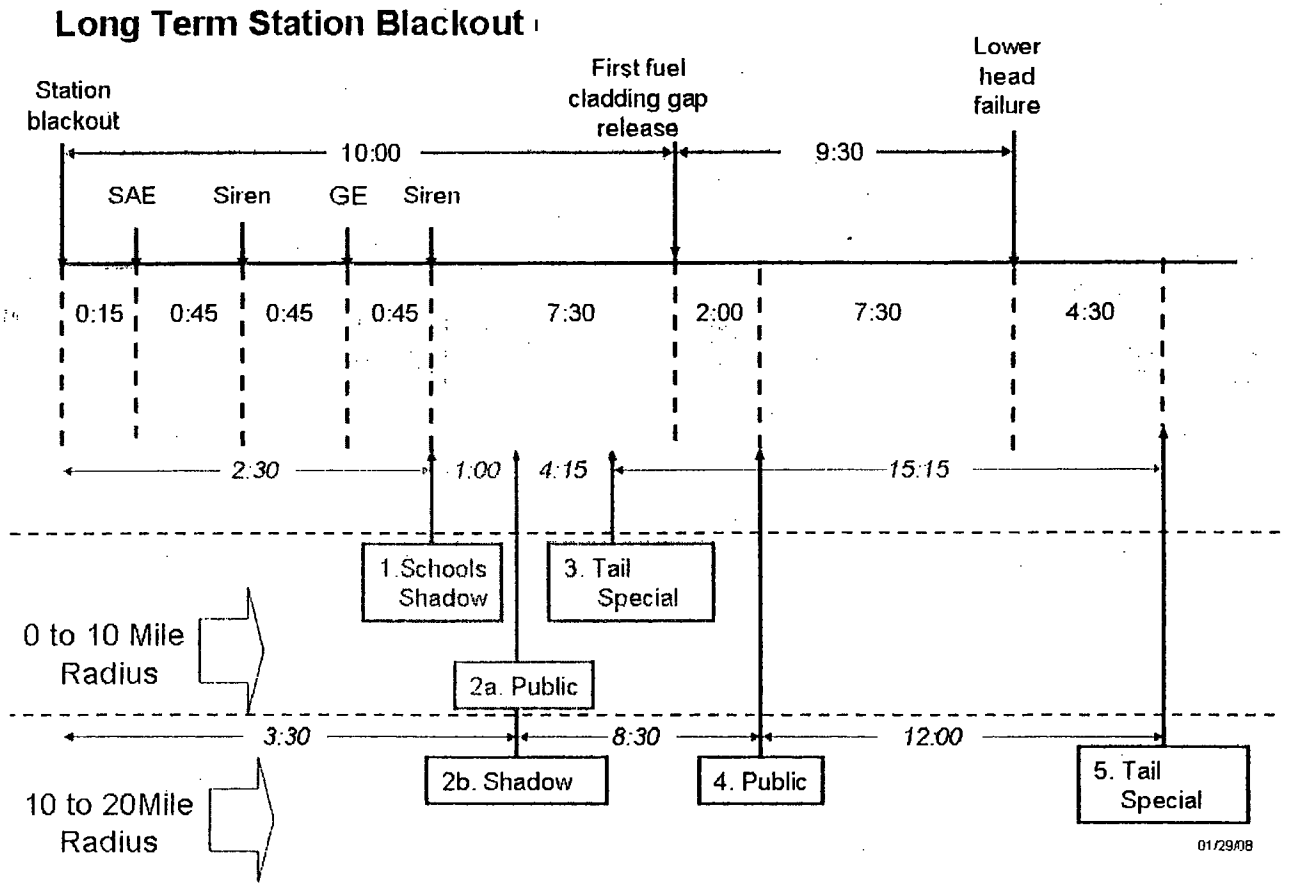
Example Accident

- Long Term Station Black Out scenario
- General Emergency is declared about 1 hour after loss of all A/C power
  - Evacuation starts at General Emergency

Example Evacuation Cohorts

#	Cohort	Population
1	Shadow (0-10)	7,136
2	• Schools (0-10) • Shadow (10-20) • Special Needs (0-10) • Tail (0-10)	12,215 39,226 400 4,623 **56,464**
3	Public (0-10)	46,631
4 for sensitivity anal	Public (10-20)	310,535
5 for sensitivity anal	• Special Needs (10-20) • Tail (10-20)	17,000 23,535 **40,535**
6	Non-Evacuating (0-20)	2,318
	Total	463,619

Timeline


Long Term Station Blackout
Station blackout
First fuel cladding gap release
Lower head failure
10:00
9:30
SAE
Siren
GE
Siren
0:15
0:45
0:45
0:45
7:30
2:00
7:30
4:30
2:30
1:00
4:15
15:15
1. Schools Shadow
3. Tail Special
0 to 10 Mile Radius
2a. Public
3:30
8:30
12:00
2b. Shadow
4. Public
5. Tail Special
10 to 20Mile Radius
01/29/08

Dose Calculations

- EP Modeling is set up and then handed off to dose projection team (MACCS2 code used)
- Population movements are modeled in synch with the radiological release
- Consequences assessed more realistically

Questions?

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